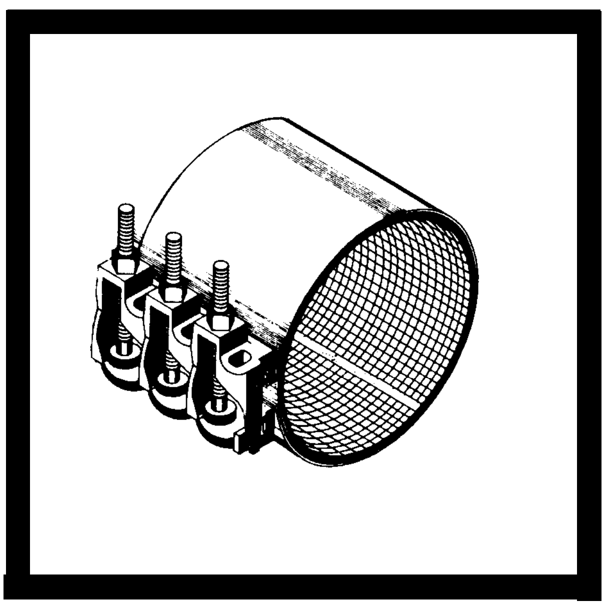
Naval Facilities Engineering Command
200 Stovall Street
Alexandria, Virginia 22332-2300



NAVFAC P-1100

# EXPEDIENT REPAIR OF UTILITY SYSTEMS MANUAL



JULY 1994

## DISTRIBUTION

One copy each

| SNDL | Title |
|---|---|
| 21A | CINCPACFLT; CINCLANTFLT |
| 23A3 | COMUSNAVCENT (N42) |
| 24D | COMSURFPAC; COMSURFLANT |
| 26C | COMNAVBEACH GRU TWO; COMNAVBEACH GRU ONE |
| 39B | COMSECONDNCB; COMTHIRDNCB |
| 39C | NCR 20TH; NCR 31ST |
| 39D | NMCB 1, 7, 74, 133; |
| 39D | NMCB 3, 4, 5, 40 |
| 39E | PHIBCB TWO; PHIBCB ONE |
| 39G | UCT TWO; UCT ONE |
| A3 | CNO (OP44G) |
| C82A | ENGFLDACT MEDITERRANEAN NAPLES IT |
| FA7 | NAVSTA ROOSEVELT ROADS PR |
| FA32 | CBU 410, 411, 412, 414, 415, 420, 423, 425, 427 |
| FB6 | COMFLEACT KADENA OKINAWA |
| FB10 | NAVSTA GUAM |
| FC7 | NAVSTA ROTA SP |
| FC14 | NAS SIGONELLA IT |
| FB41 | CBU 405, 406, 409, 413, 416, 417, 418, 421 |
| FB54 | PWC Yokosuka; Guam; Pearl Harbor |
| FF49 | CBU 403, 422 |
| FKA1C | COMNAVFACENGCOM (12) |
| FT18 | CBU 401, 402, 404, 407, 408, 419 |

Stocked at the Civil Engineer Support Office. To obtain additional copies write to Commanding Officer, Code 155, 1000 23rd Avenue, Port Hueneme, California 93043-4301, or telephone DSA: 551-3070 or commercial: (805) 982-3070.

## FOREWORD

1. The NAVFAC P-1100, *Expedient Repair of Utility Systems Manual,* identifies materials, equipment, and procedures to provide for the rapid restoration of utilities during wartime. Techniques are provided for quick temporary repair, or the use of alternate Stand-Alone System utility sources to obtain immediate restoration of services. Technology is within the capability of the Naval Construction Force (NCF) personnel as well as shore facilities public works personnel.

2. The Civil Engineer Support Office (CESO), Advanced Base Functional Component Department, Code 155, at the Naval Construction Battalion Center, Port Hueneme, California, 93043-4301, has been assigned the management responsibility for the expedient repair of utility systems program.

3. Users are encouraged to submit recommendations to CESO for improvements to this manual that include ideas which may result in a more usable publication at the field level. Suggestions for improvement of style, presentation, or content are earnestly solicited.

4. This publication is certified as an official publication of the Command and has been approved in accordance with SECNAVINST 5600.16A.

R. M. GALLEN, REAR ADMIRAL, CEC, U. S. NAVY
Vice Commander
Naval Facilities Engineering Command

# CHANGE RECORD

| Change No. | Date | Title or brief description | Signature of validation officer |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## DISCLAIMER

1. The results of this study depended, to a great extent, on the willingness of manufacturers and other agencies to provide information on a variety of coupler products. Field testing was not performed to confirm manufacturers claims as the products listed have been used commercially for years.

2. This publication addresses expedient repair practices under non Chemical, Biological, and Radiological (CBR) warfare conditions. Issues associated with repair practices under CBR conditions are extremely complex and are beyond the scope of this project.

## CONTENTS

## LIST OF FIGURES



## LIST OF TABLES

# CHAPTER 1. PURPOSE OF THE PUBLICATION

## 1. INTRODUCTION

**a. Purpose.** The purpose of this publication is to identify materials, equipment, and procedures to provide rapid restoration of mission critical facilities in wartime. The emphasis is on techniques for quick temporary repair actions or utilization of alternate utility sources (Stand-Alone Systems) for immediate restoration of services. Expedient repairs are to be performed primarily by the Naval Construction Force (NCF) personnel, although the technology is also within the capabilities of station public works organizations.

(1) Utilities addressed are:
- (a) Water
- (b) Petroleum, Oil, and Lubricants (POL)
- (c) Sanitary
- (d) Steam
- (e) Electric

(2) Stand-Alone Systems addressed are:
- (a) Water
- (b) Petroleum, Oil, and Lubricants (POL)
- (c) Electrical Power

**b. Scope**

(1) Commercially available nondevelopmental technology applicable to rapid utility repair is discussed. Emphasis is on simple repair methods using light, portable materials, equipment, and tools.

(2) This publication is generic in nature, which means that it addresses a systems approach to problem solving rather than site specific applications. Individual commands may take general recommendations contained in the manual and adapt them to a site specific application. Materials, tools, and equipment may be procured and stockpiled as desired. Procurement information is also provided.

(3) Training requirements for expedient repair technology is addressed. The primary intent is to address deficiencies for future corrective action.

*c. Background*

**(1) <u>Approach Taken</u>.** To obtain a baseline of utility information for a generic approach, utility AS-BUILT information was solicited from 10 sources, including 7 overseas bases. The information obtained from this collective effort serves as the framework of this publication. The lists of utility sixes and types of material referred to is by no means exhaustive. Common systems likely to be encountered in the field are listed.

**(2) <u>Difficulties Encountered.</u>** Research into the commercial sector indicated that the commercial world does not do expedient (quick and dirty) repairs; they perform safe, slower, permanent repairs. As a result, the Civil Engineer Support Office (CESO) has found *no new* off-the-shelf technology applicable to rapid utility repair. Research has yielded coupler technology as the only off-the-shelf viable candidate for use in rapid repair of damaged POL, water, sewer, and steam lines. While repair coupler technology is not a new item to the Naval Construction Force, its application as a rapid utility repair instrument may be underutilized.

Although originally part of the project tasking, no new off-the-shelf technology was found for telephone and electric utilities. Electric utility repair that uses conventional practices is included in this publication due to its importance as a utility, and also due to potential dangers associated with repair practices. Telephone repair has been excluded. Use conventional telephone repair techniques.

It is possible that repairs of POL lines may exceed the 4-hour repair limitation, as described in chapter 2, due to safety requirements.

**(3) <u>Damages Due to Hostile Actions</u>.** It is not the intent of this publication to predict the type, quantity, or severity of hostile action damage likely to occur at military installations. It is assumed that runways, taxiways, aircraft shelters, utility lines, munitions storage, and key command facilities will be primary targets during attack. It is also assumed that bases will face extensive utility system damage which will need to be repaired to restore base operability. The repairs will need to be accomplished as quickly as possible with limited resources. The emphasis of this publication is to address damage repair to utilities caused by conventional bomb explosions, under non Chemical, Biological, and Radiological (CBR) warfare conditions. Fire suppression, debris removal, ordnance disposal, and safety procedures are not covered in this publication.

# CHAPTER 2. BASIS OF CRITERIA USED

## 1. INTRODUCTION

### a. Repair Criteria

(1) Repair Time -- a maximum downtime of 4 hours is allowable. This does not include time required for fire suppression, debris removal, ordnance disposal, or excavation.

(2) Operational Life -- repairs must last 30 days.

(3) Resumption of Services -- repairs must provide an 80 percent resumption of services. Repairs are to be performed by NCF or station forces.

(4) Repair Technology -- repairs are centered on commercial, off-the-shelf, nondevelopmental technology.

(5) Accentable Leakage -- the acceptable leakage for water, sewer, and steam is 20 percent, and for POL is 0 percent.

**b. Coupler Description.** Couplers are simple mechanical clamps made of stainless steel and ductile iron designed primarily to repair damaged utility pipe lines in the field using a minimal amount of equipment, manpower, and repair time. Repairs can be made in or out of water and above or below ground. Damage repairable by couplers may range from pipe pin holes to full pipe breaks. Damage is assumed to be caused by hostile action, although couplers can be used to repair damage caused by natural causes. Figure 2-l shows an in-crater repair, using couplers.

This publication refers to two styles of couplers: Full Circle (open side) and Closed Circle (closed side). A description of each follows.

(1) The Full Circle (open side) couplers are the most preferable and are recommended to repair water, sewer, and POL lines. A full circle coupler is fast and simple to install. The coupler is wrapped around the pipe, properly positioned over the area to be repaired or connected, and the bolts tightened. This compacts the rubber gasket tightly against the full circumference of the pipe wall, to form a leak resistant seal. Figure 2-2 shows a Full Circle (open side) coupler.

(2) The Closed Circle (closed side) coupler is used for steam applications. Pipe ends are pushed into the coupler. As the coupler bolts are tightened the gaskets in the coupler compress to form a leak resistant seal. Figure 2-3 shows a Closed Circle (closed side) coupler.

**c. Advantages and Disadvantages of Coupler Technology.** Couplers have been used commercially for years and are readily available for procurement. Couplers offer speedy, easy installation with a minimal amount of required tools, provide permanent repairs, and are generally leak proof.

Coupler technology is generally applicable to straight runs of pipe, thereby restricting repairs at junctions where a change in direction occurs. However, valves, fittings, etc., may be bypassed or replaced using coupler technology. When replacing fittings such as Tees or Elbows using couplers, thrust blocks must be installed on all comers and intersections to prevent the coupler from pulling apart from the pipe, or the fitting from pulling apart from the coupler, due to the internal pressure of the system. Figure 2-4 shows valve repair using couplers.

Couplers can be used as the sole repair material for pipe punctures; but, hardwall pipe is required as a replacement for complete breaks. Replacement sections must also be hardwall pipe, although the type of material used for replacement may vary. Pipe sections can be heavy and cumbersome, particularly in the larger sixes. Generally, couplers only work for a given size pipe, thereby requiring a stockpile of different sixes of couplers, and also a stockpile of different sizes of replacement piping.

**d. Design Criteria.** Table 2-l lists temperature and pressure requirements used in the selection of couplers. The amount of pressure that a coupler can contain will vary, based upon the size of the coupler, the type and extent of damage, environmental conditions, and installation workmanship. The temperature range of the couplers will vary, based upon the type of gasket material used. Couplers specified in this publication, with the exception of steam applications, provide a minimum pressure rating of 150 psi at a minimum temperature range of 0°F to 150°F. Couplers specified for steam applications provide a minimum pressure rating of 150 psi at a minimum temperature range of 0°F to 600°F.

**TABLE 2-1. Temperature and Pressure Requirements**

| Utility | Pressure (psi) | Temperature (°F) |
|---|---|---|
| Water | 150 | 0° - 125° |
| Sewer | N/A | 0° - 125° |
| POL | 150 | 0° - 125° |
| Steam | 150 | 360° - 500° |

**e. Desirability Criteria.** The following criteria, used to define the desired features of couplers, are based primarily on input from military personnel experienced in NCF utility repair:

(1) The coupler should be of the “full circle” open-side type vs rigid slide-/push-on type.

(2) The coupler should have no detached bolts; bolts should be part of coupler.

(3) The coupler gaskets should have a 5-year shelf life.

(4) the bolts on the coupler should use an adjustable wrench for tightening; Allen wrenches are not required.

(5) The coupler should be sized and marked in English units, as procurement will be by domestic sources.

(6) The coupler should be self restraining.

(7) The coupler must satisfy temperature requirements of product serviced.

(8) The coupler must provide chemical resistance for product serviced.

(9) The coupler should have a tolerance for misalignment of pipes.

(10) The coupler should have an allowance for a variation in pipe diameter.

**f. Couplers Selected for Expedient Repair**

(1) Dresser

(2) Rockwell

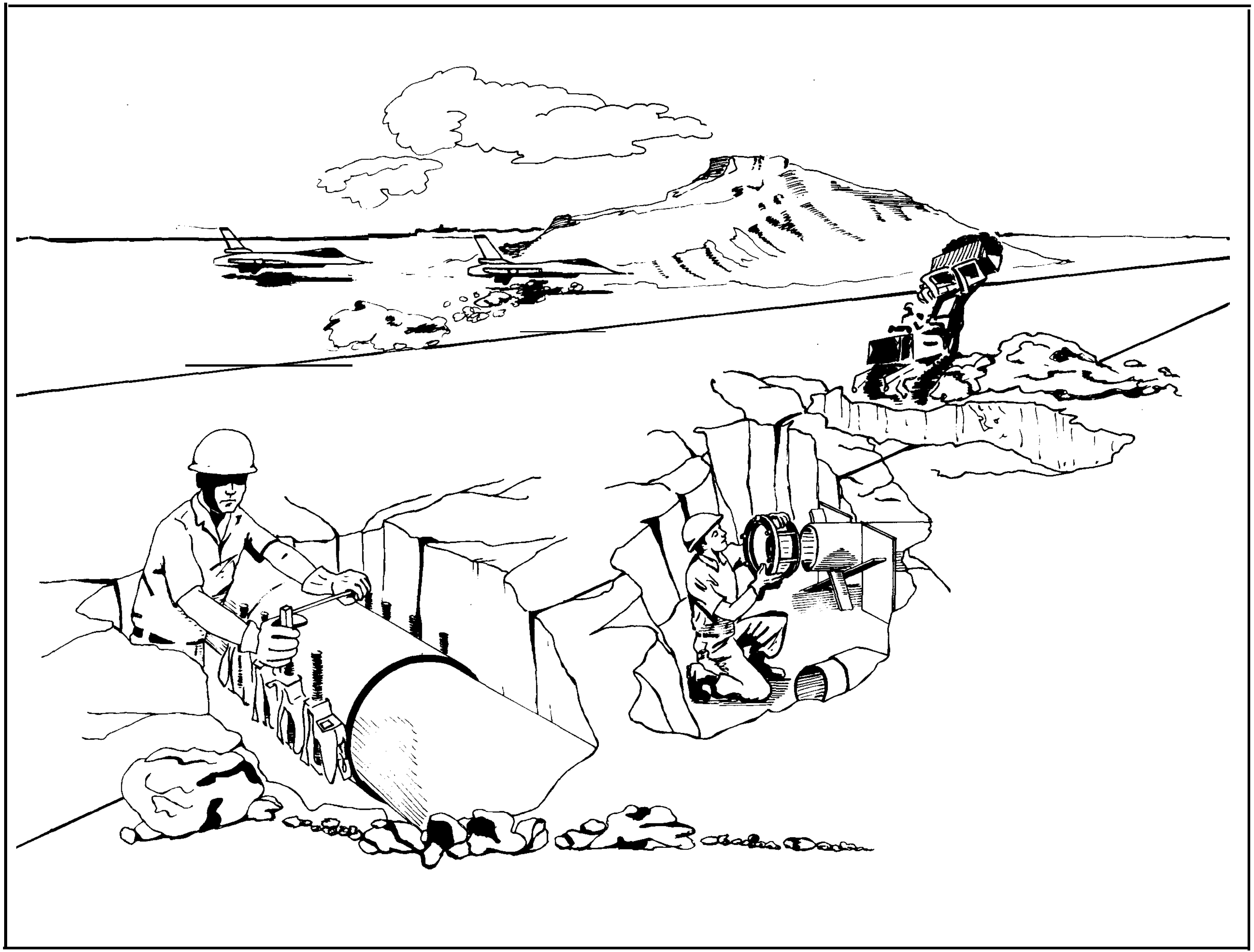
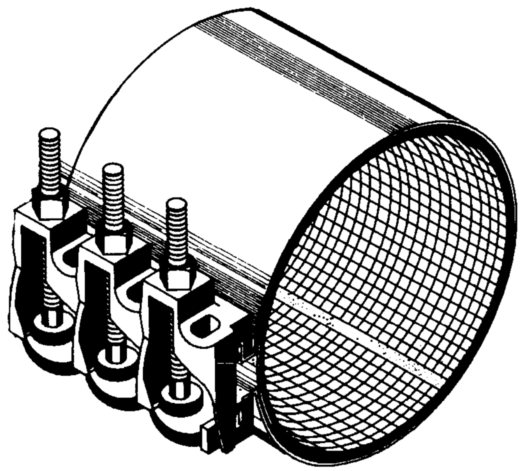
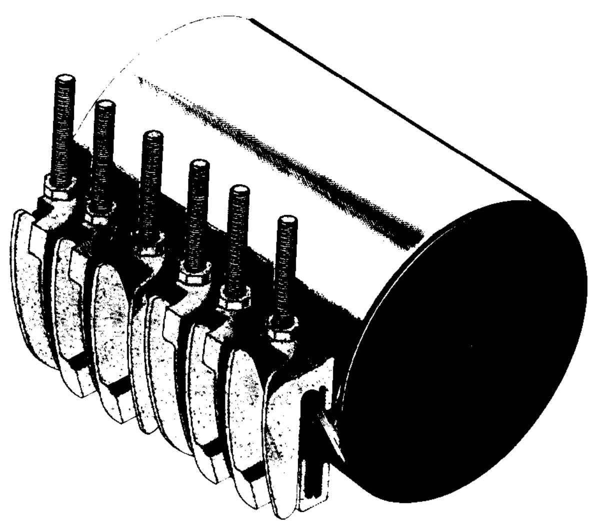


FIGURE 2-1
In-Crater Repair

FIGURE 2-1. In-Crater Repair



***Rockwell Model 225***
Single band full circle clamp coupler



***Dresser Model 360***
Full circle clamp coupler

**FIGURE 2-2. Full Circle Coupler**

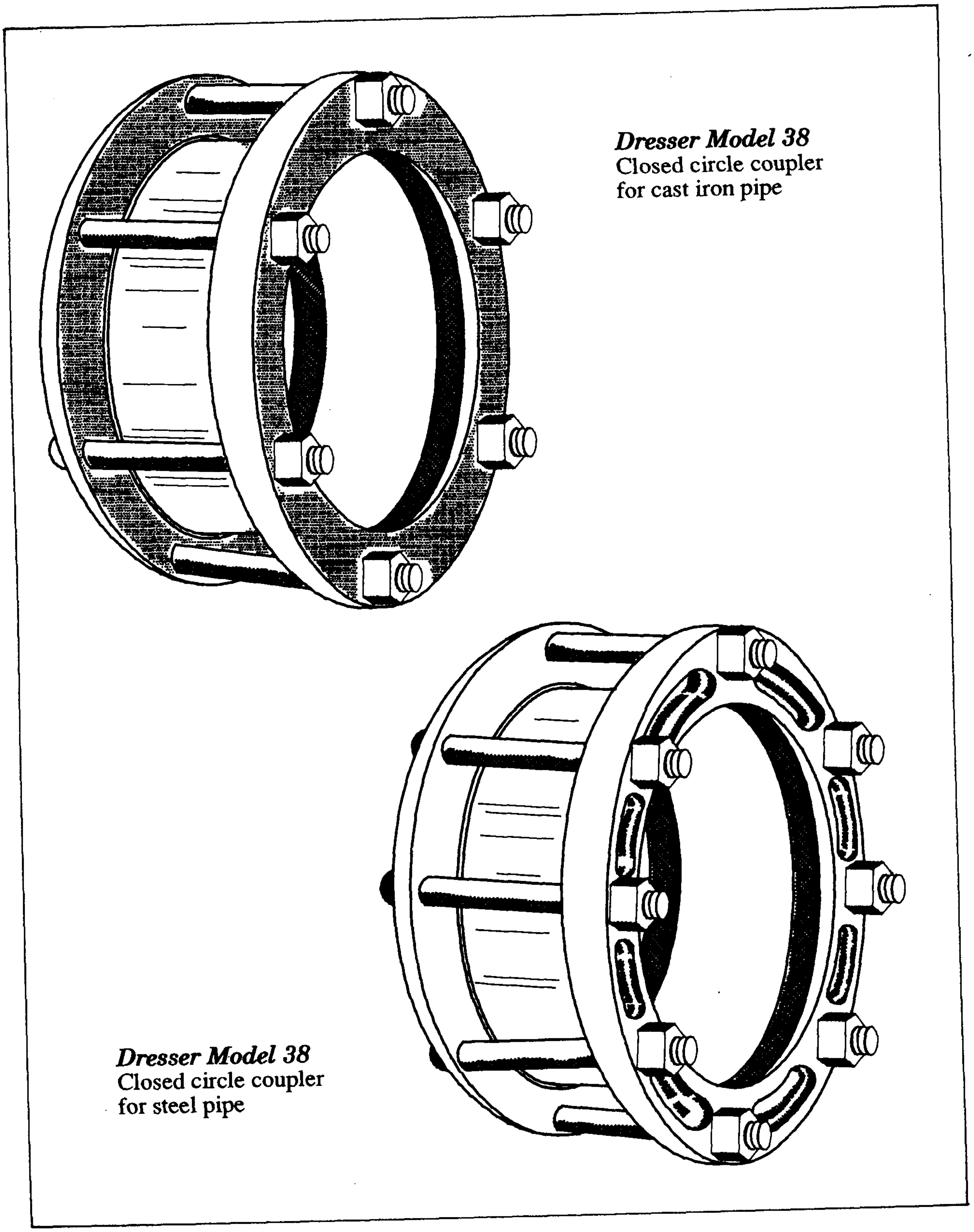



**FIGURE 2-3. Closed Circle Coupler**

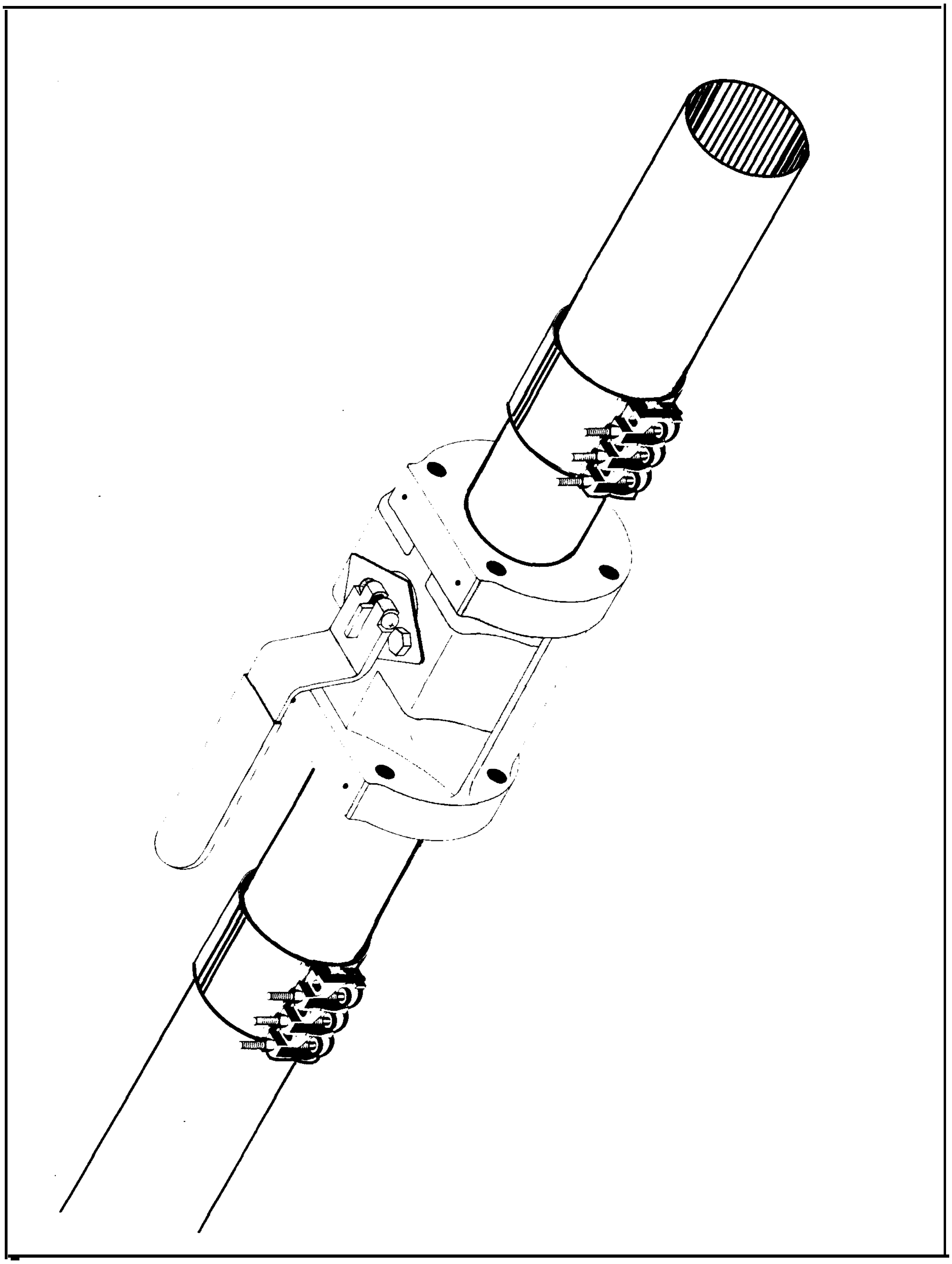



**FIGURE 2-4. Valve Repair Using Coupler**

# CHAPTER 3. BRIEF DESCRIPTION OF UTILITY SYSTEMS

## 1. WATER UTILITY SYSTEM

**a. Description.** The base water distribution system is normally fed by a main water line ranging from 12 inches to 24 inches in diameter. The water source may be provided by the base or by local utility companies. A water treatment plant is normally located near the source, and is used to treat the raw water before distribution.

The water distribution systems may include pipe sizes that range from l-1/2 inches to 24 inches in diameter. Pipe materials may consist of PVC rigid plastic pipe, steel, asbestos cement, cast iron, and ductile iron. Components of the water distribution systems are hydrants, valves, meters, storage tanks, reservoirs, pumps, water purification systems, piping, and thrust blocks. Water pressures in the distribution system range from 60 to 120 psi.

**b. Nonrepairable Components.** Water distribution system components, such as water storage tanks, pumps, and purification units, are considered nonrepairable because normal repairs exceed the 4-hour time limitation for repair. On a temporary basis, these components may be replaced individually with stand-alone systems (see chapter 4).

**c. Repairable Components.** Most water distribution lines are considered repairable because they can generally be repaired within a 4-hour period.

## 2. SEWER UTILITY SYSTEM

**a. Description.** A typical sewage system consists of relatively large trunk lines as the main, and smaller service lines, which branch off the trunk lines to service the base facilities. Trunk lines can vary from 8 inches to 24 inches in diameter. Service lines are usually 4 inches to 6 inches in diameter. Pipe materials may consist of asbestos cement, cast iron, ductile iron, concrete, PVC, and vitrified clay. Wastes are carried primarily by gravity flow to sewage treatment plants for treatment before final discharge into selected medians. Lift stations, with associated pumps, are often employed in sewage systems.

**b. Nonrepairable Components.** Sewage treatment components, such as sewage treatment plants are considered nonrepairable because of the 4-hour time limitation for repair. Well and sump pumps can be replaced if damaged.

**c. Repairable Components.** Sewer trunk and service lines are considered repairable because they can generally be repaired within a 4-hour period.

## 3. PETROLEUM, OIL, AND LUBRICANTS (POL) UTILITY SYSTEMS

**a. Description.** The typical POL system consists of loading pipe lines from ship tanker to shore terminal POL. The shore terminal POL consists of booster pumping stations, storage tanks, manifolds, transfer pumps, flood pumps, pipeline pumping stations, main pipelines, reserve storage tanks, dispensing tanks, filtering devices, bulk distribution lines, and loading and unloading stations.

Pipelines employ coupler or flange fittings to join steel pipes. Piping material used in the distribution lines are made of lightweight steel. The pipe is strong enough to withstand average line and surge pressures of 300 psi. The pipelines are either above or below ground and are usually welded. Piping manifold, valves, and distribution branches are usually installed above ground. If installed below ground, piping manifold and valves are enclosed in a pit. The most common sizes of steel pipes used range from 3 inches to 12 inches. Larger sizes of 14 inches to 24 inches are used in Navy shore facilities that have major POL terminal facilities.

**b. Nonrepairable Components.** Pumping and transfer stations, storage and dispensing tanks, and manifolds are generally considered nonrepairable due to the 4-hour time limitation. Valves and fittings are nonrepairable in the field. They should be replaced when damaged. A complete expedient ABFC-type stand-alone facility is available for use as a substitute system (see chapter 4).

**c. Repairable Components.** Damaged pipelines are repairable. Damaged submarine pipelines can be restored back to service by a SCUBA diving repair team. Trunk or main lines, whether below or above ground, can be repaired with couplers.

## 4. STEAM UTILITY SYSTEM

**a. Description.** The main steam distribution lines are made of steel pipes and range in size from 1 inch to 10 inches. The main condensate lines, either gravity type, pumped type, or the counterflow type, are also made of steel and range in size from 1 inch to 8 inches.

**b. Nonrepairable Components.** When a steam plant facility is severely damaged, it should be abandoned.

**c. Repairable Components.** Main distribution lines are repairable within the 4-hour period using coupler technology. Damaged steam plant components can be repaired by replacement. The steam plant component parts are as follows:

(1) Boiler -- replaceable with packed type

(2) Boiler Feed Pumps -- replaceable

(3) Feed Water Heater -- replaceable

(4) Condensate Receiver Tank/Pump -- replaceable

(5) Steam Header -- replaceable

(6) Valves and Fittings -- replaceable

(7) Manholes -- replaceable

## 5. ELECTRICAL UTILITY SYSTEM

**a. Description.** Electrical utility systems consist of main power plants, substations, switch-gear, transformers, vaults, manholes, utility and power poles, overhead and underground conductors, and all associated hardware. Power is supplied by either station power plants, or obtained from local civilian sources, and distributed throughout the station via substations, switch-gear, and utility lines.

A variety of voltages are found throughout the Navy, ranging from 4kV to 60kV, with conductors from #6 AWG to 800 MCM. Three basic types of distribution systems exist; (1) the radial, (2) the loop, and (3) the network.

The *radial system* is a basic independent feeder line that branches out to several distribution centers without intermediate connections between feeders. This is the simplest and cheapest to construct, but also the least efficient.

The *loop system* starts at the substation and is connected to, or encircles, an area that serves one or more distribution transformers or load centers; the conductors of the system return to the same substation. This system is more reliable than the radial system, but costs more and is more labor intensive to maintain.

*The network system* uses the independent feeder system of the radial system to supply power to the distribution transformers, and parallels the secondaries that use the loop concept, which allows for optimum flexibility and efficiency. A part or all of these three systems will be found through out the Navy System.

**b. Nonrepairable Components.** Nonrepairable items compose the larger portion of the electrical distribution system which will probably receive damage in the event of hostile attack. These items normally require replacement or alternate items to be used. The following is a list of the items which probably <u>will not</u> be repairable:

| | | | |
|---|---|---|---|
| (1) Poles | (3) Insulators | (5) Capacitors | (7) Lightning Protection |
| (2) Crossarms | (4) Transformers | (6) Switch Gear | (8) Power Plant |

Electrical lines and conductors, and cables are normally the extent of the repairable items of an electrical utility system, although some switch-gear and miscellaneous hardware may be repairable, depending upon the extent of damage. For the purpose of expedient repair, this publication primarily deals with repair of overhead and underground power lines and conductors. Complete expedient ABFC-type stand-alone facilities are available for use as a substitute system (see chapter 4).

**c. Repairable Components.** Within the electrical distribution system only a few items will be of repairable nature. Depending on the amount of destruction received on station, and on the amount of available resources, the following is a list of the most probable items which will be repairable:

| | |
|---|---|
| (1) Conductors | (3) Grounding Wires |
| (2) Guy Wires | (4) Anchors |

# CHAPTER 4. RAPID UTILITY SYSTEM REPAIR PROCEDURES

## 1. INTRODUCTION

**a. Purpose.** This chapter provides a macro-overview of the on-site repair process. It is not intended to address every scenario that can occur; rather, the objective is to identify important areas that should be addressed. Specific responses to utility service disruption should be tailored to the uniqueness of each situation. Much of the repair process is based on use of common sense in conjunction with practical experience.

## 2. WATER UTILITY SYSTEM

**a.** *Damage Assessment.* Before damage repair is started, the following considerations should be addressed:

(1) Determine if the damaged line is vital to mission support.

(2) Establish a repair priority if more than one line is damaged.

(3) Determine if the distribution line can be shut off, plugged, and abandoned.

(4) Determine if debris removal and ordnance disposal is required.

(5) Determine if the damaged component can be replaced with a portable, temporary, Stand-Alone System.

(6) Determine what safety issues need to be addressed.

(7) Determine what personnel, tools, and equipment are required for repairs.

**b.** *Repair Materials.* See appendix A.

*c. General Tools and Equipment.* See appendix B.

**d.** *Repair Consumables.* See appendix C.

*e. Site Preparation*

(1) Ensure ordnance has been cleared from area.

(2) Shut off water supply.

(3) For below ground repairs, remove standing water as required so that damaged piping is exposed to the extent possible, and preliminary damage assessment can be performed.

(4) For below ground repairs, remove debris and excavate until damaged pipe section is fully exposed and secondary damage assessment can be performed. Continue to excavate around the damaged piping until undamaged pipe sections are found. The pipe sections must be round and in close alignment.

**f. Installation.** See appendix D.

**g. Safety Precautions.** Normal safety practices associated with water repair should be followed. Upon completion of temporary repairs, the trench should be covered with plywood or steel matting until permanent repairs are made.

**h. Stand-Alone System.** The following complete and self-supporting system is listed for consideration of usage in the event utility sources are destroyed and resumption of services is vital. Stand-Alone systems are based upon advanced base functional component (ABFC) technology which can be procurred. For current procurement information contact:

Commanding Officer
Attn: CESO Code 155
1000 23rd Avenue
Naval Construction Battalion Center
Port Hueneme, CA 93043-4301

(1) Description. The Water Utility Stand-Alone System consists of 400-gallon-per-minute pump, a 3000-gallon stave or onion/doughnut tank used for pretreatment storage, a 3000-gallon-per-hour water purification unit, three 10,000-gallon post-treatment pillow tanks and miscellaneous hose distribution systems. The unit is designed to draw, treat, store, and dispense fresh or brackish water. It is not designed to treat salt water. See figure 4-1 for an operational schematic of the system.

(2) Bill of Materials. Table 4-l lists procurement information for the Stand-Alone System.

**TABLE 4-1. Bill of Materials for Water Utility System**

| Facility Number | Description | Weight (Lb) | Volume ($ft^3$) | Cost ($) |
|---|---|---|---|---|
| 84140EX | Water Supply Emergency 40,000 gallons | 9959.5 | 719.5 | 77,157.53 |

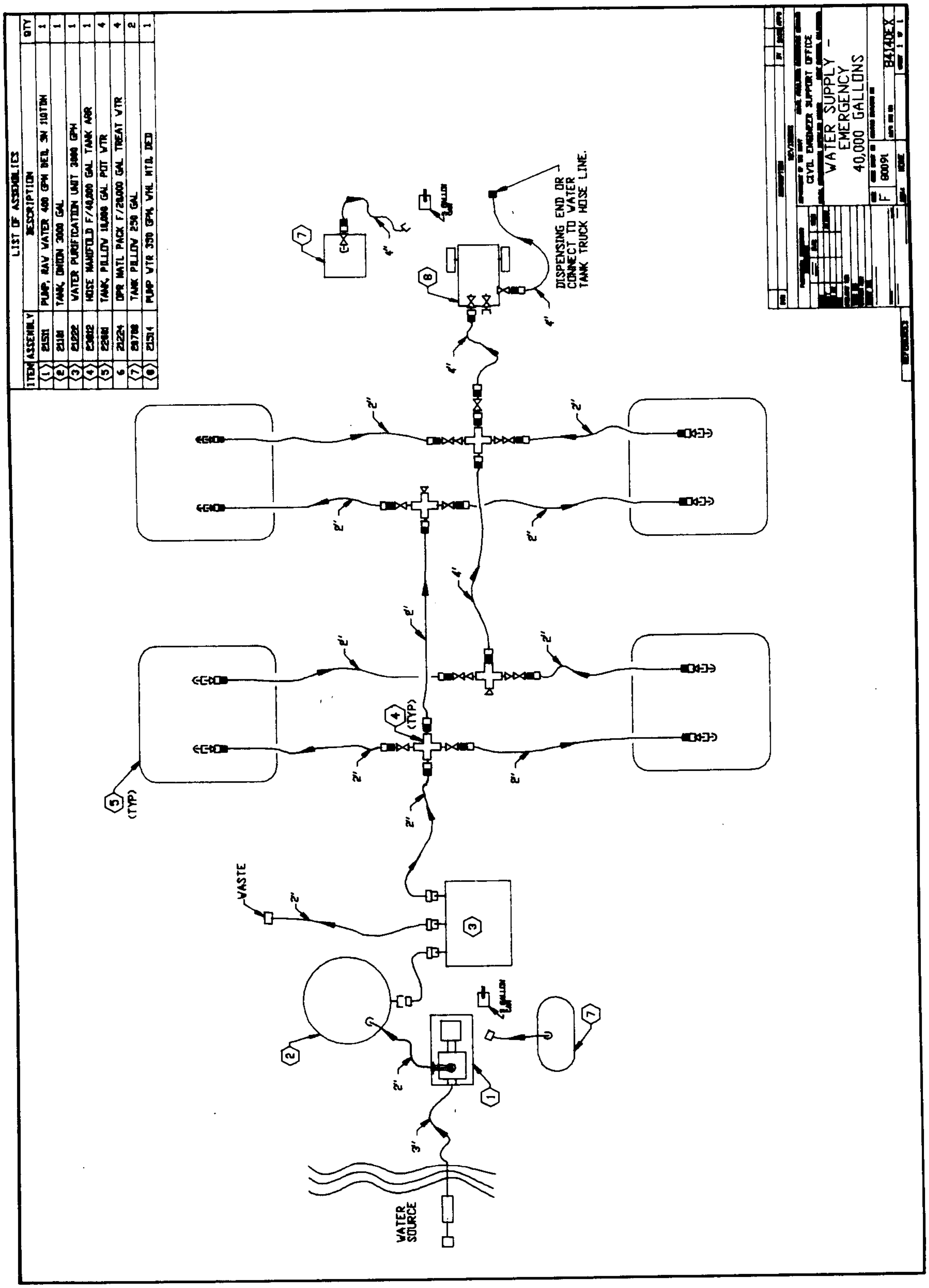



FIGURE 4-1. Water Utility Stand-Alone System Operational Schematic

FIGURE 4-1. Water Utility Stand-Alone System Operational Schematic

## 3. SEWER UTILITY SYSTEM

**a. Damage Assessment.** Before damage repair is started, the following considerations should be addressed:

(1) Determine if the damaged line is vital to mission support.

(2) Establish a repair priority if more than one line is damaged.

(3) Determine if the distribution line can be plugged and abandoned.

(4) Determine if debris removal and ordnance disposal is required.

(5) Determine what safety issues need to be addressed.

(6) Determine what personnel, tools, and equipment are required for repairs.

**b. Repair Materials.** See appendix A. Other products suitable for sewer repair are available, but couplers specified for water and POL utilities will also work on sewer applications. Their common usage avoids the necessity to stockpile an excess of materials.

**c. General Tools and Equipment.** See appendix B. In addition to the list in appendix B, vent fans and portable generators are also recommended.

**d. Repair Consumables.** See appendix C.

**e. Site Preparation.** Before damage repair is started prepare the area as follows:

(1) Ensure ordnance has been cleared from area.

(2) For below ground repairs, remove sewage sludge as required so that damaged piping is exposed to the extent possible so that preliminary damage assessment can be performed.

(3) For below ground repairs remove debris and excavate until damaged pipe section is fully exposed so that secondary damage assessment can be performed. Continue to excavate around the damaged piping until undamaged pipe sections are found. The pipe sections must be round and in close alignment.

**f. Installation.** See appendix D. For sewer applications, only snug: down the bolts. Do not torque to recommendations.

**g. Safety Precautions.** Normal safety practices should be followed. Particular care should be given to health related issues associated with work around raw sewage. Ensure that adequate ventilation is present at all times. Upon completion of temporary repairs, the trench should be covered with plywood or steel matting until permanent repairs are made.

## 4. PETROLEUM, OIL, AND LUBRICANTS (POL) UTILITY SYSTEM

**a. Damage Assessment.** Before damage repair is started the following consideration should be addressed:

(1) Determine if the damaged line is vital to mission support.

(2) Establish a repair priority if more than one line is damaged.

(3) Determine if the distribution line can be shut off, plugged, and abandoned.

(4) Determine if fire suppression, fuel removal, debris removal, and ordnance disposal is required.

(5) Determine if the damaged component should be replaced with a portable, temporary Stand-Alone System.

(6) Determine what safety issues need to be addressed.

(7) Determine what personnel, tools, and equipment are required for repairs.

**b. Repair Materials.** See appendix A. For POL lines, the short term use of PVC pipe as a replacement is acceptable for pipe sixes equal to or smaller than 12 inches. Replacement of pipe systems greater than 12 inches require steel piping. Steel piping is recommended for all pipe sixes where the repair life must exceed 30 days.

**c. General Tools and Equipment.** See appendix B. In addition to the list in appendix B, vent fans, fire extinguishers, and portable generators are also recommended.

**d. Repair Consumables.** See appendix C.

**e. Site Preparation.** Before damage repair is started prepare the area as follows:

(1) Shut off POL supply.

(2) Ensure ordnance has been cleared from area.

(3) Address any potential fire hazards. Operate hazardous vapor suppression equipment, as required.

(4) For below ground repairs remove all standing POL. Perform preliminary damage assessment.

(5) For below ground repairs remove debris and excavate until damaged pipe section is fully exposed so that secondary damage assessment can be performed. Continue to excavate around the damaged piping until undamaged pipe sections are found. The pipe sections must be round and in close alignment.

**f. Installation.** See appendix D.

**g. Safety Precautions.** Safety practices associated with flammable liquids or vapors should be followed. Each Navy shore facility has the responsibility to develop techniques for fire fighting bomb damaged POL pipe lines, to remove fuel from the crater, suppress fuel vapors while repairs are made, and to use explosive-proof equipment. Upon completion of temporary repairs, the line should be reactivated to check for leaks. If the repairs exhibit no leaks, the trench should be covered with plywood or steel matting until permanent repairs are made.

**h. Stand-Alone System.** The following complete and self-supporting system is listed for consideration for use in the event utility sources are destroyed and resumption of services is vital. Stand-Alone systems are based upon advanced base facility component (ABFC) technology and can be procurred. For current procurement information contact:

Commanding Officer
Attn: CESO Code 155
1000 23rd Avenue
Naval Construction Battalion Center
Port Hueneme, CA 93043-4301

(1) Description. The POL Utility Stand-Alone System consists of two 20,000-gallon fuel pillow tanks used for storage, a 350-gallon-per-minute pump, two filter-strainers, and miscellaneous hose distribution systems. The unit is designed to receive, store, and dispense POL. If a larger capacity is anticipated, use two or more of these systems. Figure 4-2 shows an operational schematic of the system.

(2) Bill of Materials. Table 4-2 lists procurement information for the Stand-Alone System.

**TABLE 4-2. Bill of Materials for POL Utility System**

| Facility Number | Description | Weight (Lb) | Volume ($ft^3$) | Cost ($) |
|---|---|---|---|---|
| 12310XX | Fuel Storage and Dispensing Station 40,000 Gallons | 12,276.0 | 289.2 | 106,681.77 |

FIGURE 4-2. POL Utility Stand-Alone System Operational Schematic

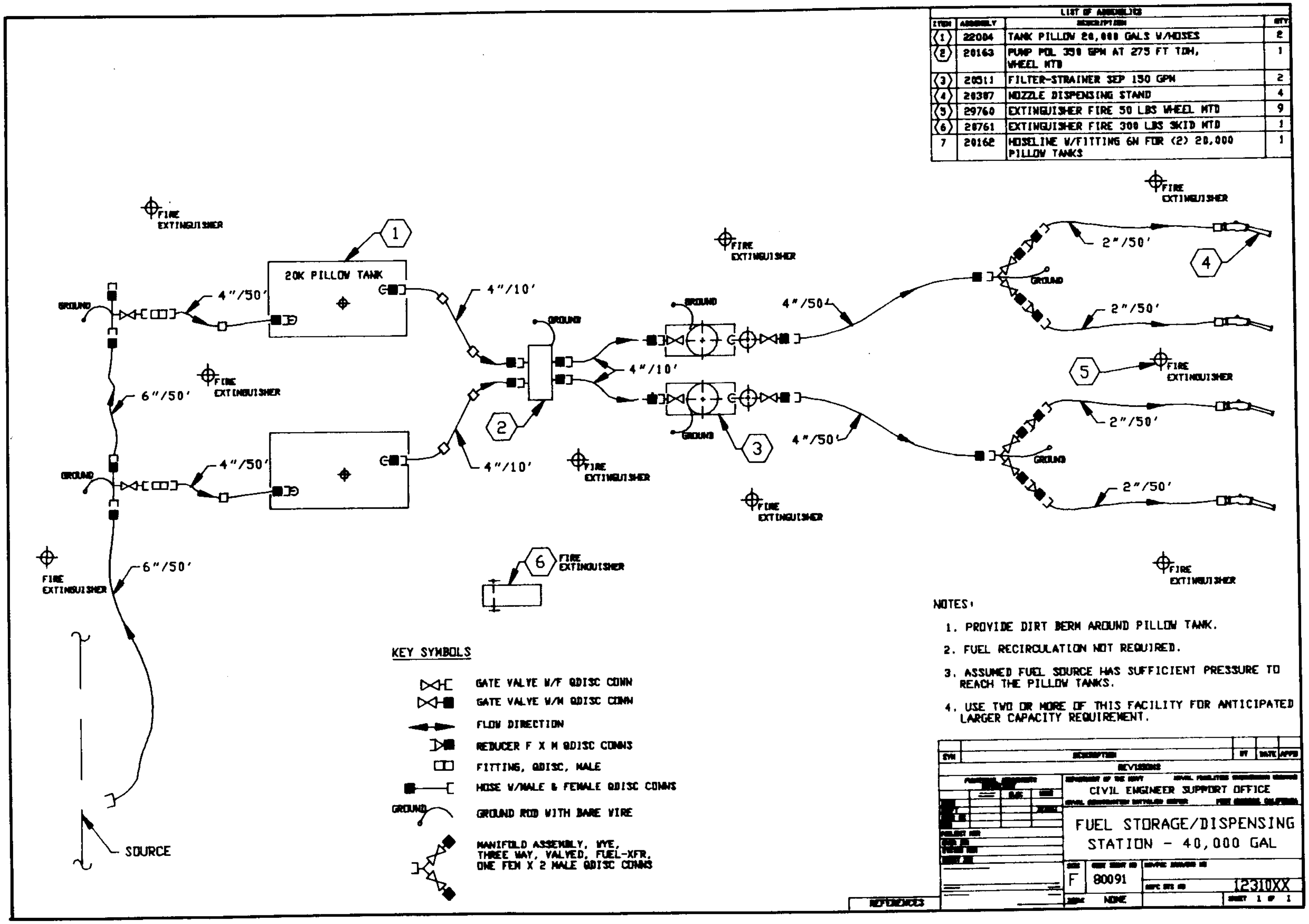



FIGURE 4-2. POL Utility Stand-Alone System Operational Schematic

## 5. STEAM UTILITY SYSTEM

**a. Damage Assessment.** Before damage repair is started the following considerations should be addressed:

(1) Determine if the damaged line is vital to mission support.

(2) Establish a repair priority if more than one line is damaged.

(3) Determine if the distribution line can be shut off, plugged, and abandoned.

(4) Determine if debris removal and ordnance disposal is required.

(5) Determine what safety issues need to be addressed.

(6) Determine what personnel, tools, and equipment are required for repairs.

**b. Repair Materials.** A variety of pipe sizes is used in the field. Steel is the predominant material used for steam applications. *Dresser Model 38 Coupler with a high temperature non-asbestos gasket for steam* is recommended to repair steam pipes in sizes that range from 2 inches to 24 inches. Smaller sections than 2 inches are not considered vital to mission support. Sizes to 30 inches are available. Dresser couplers can be used where pipe ends are deflected up to 4 degrees or offset 1/8 inch. The shelf life of the gasket is 5 plus years. The coupler can also join pipes with a variation of 1/4 inch outside diameter. This tolerance can eliminate or substantially reduce problems associated with pipes that have different nominal standards. See table 4-3 for recommended torque for couplers. See table 5-4 for procurement information. There are no *Rockwell* products for steam application.

As *Dresser* couplers are made for a certain size application, it is necessary to have on hand couplers in every size likely to be encountered in the field. Individual commands can assess their own utility systems and stockpile what is deemed appropriate.

As couplers are designed to be used with hardwall pipe, it is also necessary to have pipe material on hand to be used for replacement. As in the case of couplers, individual commands can assess their utility systems and stockpile what is deemed appropriate. Each command may procure pipe material similar to what is used.

**TABLE 4-3. Recommended Torque for Couplers**

| Model | Torque (Ft-Lb) |
|---|---|
| Dresser Model 360 | 50 |
| Dresser Model 38 | |
| 3/8 inch and 1/2 inch bolts | 38 |
| 5/8 inch bolts | 75 |
| 3/4 inch bolts | 90 |
| Rockwell Model 225 | |
| Pipes 1 inch to 4.73 inches | 50 |
| Pipes above 4.73 inches | 70 |

**c. General Tools and Equipment.** See appendix B.

**d. Repair Consumables.** See appendix C.

**e. Site Preparation.** Before damage repair is started prepare the area as follows:

(1) Ensure ordnance has been cleared from area.

(2) Shut off steam supply.

(3) For below ground repairs remove standing water as required, so that damaged piping is exposed to the extent possible so that preliminary damage assessment can be performed.

(4) For below ground repairs remove debris and excavate until damaged pipe section is fully exposed and secondary damage assessment can be performed. Continue to excavate around the damaged piping until undamaged pipe sections are found. The pipe sections must be round and in close alignment.

**f. Installation.** See appendix D. For steamline applications, the pipe ends must be pushed into the closed circle coupler.

**g. Safety Precautions.** Normal safety practices associated with steam repair work should be followed. Upon completion of temporary repairs of underground utilities, the trench should be covered with plywood or steel matting until permanent repairs are made.

## 6. ELECTRIC UTILITY SYSTEM

**a. Damage Assessment.** After attack the damage assessment team will be required to determine extent, type, location, and priority of repair. The following list serves as a general guideline to the assessment leader. Please note that these are only a general guide and are not intended to be conclusive of all factors that need to be considered, as every situation varies somewhat.

(1) Determine if the damaged line is vital to mission support.

(2) Establish a repair priority if more than one line is damaged.

(3) Determine if power can be rerouted using existing switch gear.

(4) Determine if the distribution line be secured, isolated, or abandoned.

(5) Determine if ordnance disposal, fire suppression, or debris removal is required.

(6) Determine if the damaged component should be replaced with a portable, temporary Stand-Alone System.

(7) Determine what safety issues need to be addressed.

(8) Determine what personnel, tools, and equipment are required for repairs.

**b. Source.** The main power plant is the source of power, or the main power substation, if power is supplied from commercial sources. This is the starting point and acts as the operating base station during all electrical utility repairs. The main power plant, if not shut down or damaged, already receiving calls as to power outages, has information as to loss of power loads, what feeders are shut down, and normally has a complete drawing and design of the station power system.

NOTE: (1) All work is coordinated through the main power plant.

(2) Radios or a means of two-way communication is imperative between all crews and the power plant.

(1) Distribution Lines. After the power plant has provided a starting point, it is necessary to drive the route of the distribution lines, looking for visible damage. Power lines probably are the only things that are repairable within the system. Other damaged items normally have to be replaced, but on-site judgment is the final determining factor of what can and can’t be repaired.

Caution should be used whenever approaching falling power lines. All power lines should be considered hot until properly tested and properly grounded.

(2) <u>End User.</u> Normally it is not necessary to determine who is the end user, as they will have already notified the power plant that they are without power. But, should it be required to secure a section of line in order to make necessary repairs, it becomes necessary to identify and inform those users who will be shut down, prior to performing such functions.

**c. Repair Materials.** Materials for electrical distribution repair differ very little from one manufacturer to another. Listed below are some trade names for both overhead and underground repairs. Splicing sleeves, crimp sleeves, or nicopress are the most common, followed by automatic compression fittings and bolt-on-/split-bolt-type connectors. In underground splicing several insulating and sealing materials will be required. Lists of these have not been provided as they vary with the type of cable insulation and should be already on station for normal repair functions. Major manufacturers and distributors are:

Joslyn Manufacturing and Supply Company
Reliable Electric and Utility Products
Burndy Company

**d. Repair Equipment.** Equipment requirements vary with the type of work. Underground work requires earth moving equipment, wire pulling equipment, reel trailers, and lighting plants if in hours of darkness. Overhead work could require pole trucks, auger trucks, line maintenance trucks, cranes, bucket trucks, cable trailers, and light plants.

**e. Repair Tools.** Tools are inclusive of all normal line construction and maintenance tools, along with a variety of other tools such as: shovels, pikes, cant hooks, pole carriers, slings, block and tackles, come-a-longs, megohm tester, hi-pot testers, tone detectors, hot line tools, and crimping tools (normally designed for a specific type or style of crimping devise).

**f. Repair Consumables.** The following is a list of items likely to be consumed during expedient repair:

(1) Conductors and wires
(2) Insulators
(3) Hardware (nuts, bolts, washers, supports)
(4) Fuses
(5) Connectors
(6) Transformers
(7) Capacitors
(8) Lighting arrestors
(9) Switches
(10) Poles
(11) Crossarms
(12) Splicing materials (tape, sealing compound)

**g. Site Preparation.** Upon arrival of work crews:

(1) Ensure all crew members are informed on scope of work to be performed;

(2) Determine what materials will be needed to make necessary repairs;

(3) Ensure that the area has been cleared of all ordnance and debris in the immediate work area;

(4) For underground work, excavate and verify other utilities which could be collocated;

(5) Secure power to the section of line that will be worked on;

(6) Ensure that all necessary tools and equipment needed are on site or in route; and

(7) Lay out materials and hand tools as required to complete task.

**h. Installation.** Overhead installation begins once power has been secured, ordnance has been cleared, and debris has been removed. Repair or replace damaged hardware only to the extent necessary to safely support the restoration of power cables. Damaged cables are cut, spliced, and replaced on insulators. Jumpers are installed where required. When a section of line is beyond timely repair, jumpers and taps to other utility lines are used to whatever extent possible, and includes the use of portable and expedient type bypass and jumper cables which are laid on the ground until more permanent methods may be installed.

Underground damage and faults are much more labor intensive and are normally very difficult to repair in an expedient method. If rapid ability to locate and excavate cables are not available, it is best to terminate at the nearest man/hand hole and tie in expedient jumper cables to be run along the ground. This method is true for both direct burial and conductors in conduit. Connections should be made only by qualified trained personnel using approved techniques and materials. Expedient cables that run exposed on the ground must be clearly marked and protected from damage.

**i. Safety Precautions.** Safety precautions should always be adhered to. General electrical safety standards which should always be followed are listed below.

(1) Coordinate all work via one central location.

(2) Consider all ordnance to be live until proven otherwise by EOD personnel.

(3) Detonate or remove all ordnance by EOD personnel only.

(4) Do not open or close switches without permission from the main power plant or other central locations, as predetermined by proper authority.

(5) Tag out and lock all opened switches when capability exists to do so.

(6) Only qualified personnel will do all hot work, using the proper tools and techniques for this type of work.

(7) Work on energized lines will only be done in extreme emergencies.

**j. Stand-Alone Systems.** The following complete and self-supporting systems are listed for consideration of usage in the event utility sources are destroyed and resumption of services is vital. Stand-Alone systems are based upon advanced base functional component (ABFC) technology and can be procurred. See table 4-4 for generator information. For current procurement information contact:

Commanding Officer
Attn: CESO Code 155
1000 23rd Avenue
Naval Construction Battalion Center
Port Hueneme, CA 93043-4301

(1) Description. Backup utility repair systems for electrical utilities systems consist primarily of portable generators, associated hardware, load centers, cables, and fuel supply. A variety of generator sixes exist in the DoD inventory, and may be used individually or in parallel to accommodate several different load demands. Generators may be installed individually, or two to three in parallel, to provide emergency power to specific sites as required around the station.

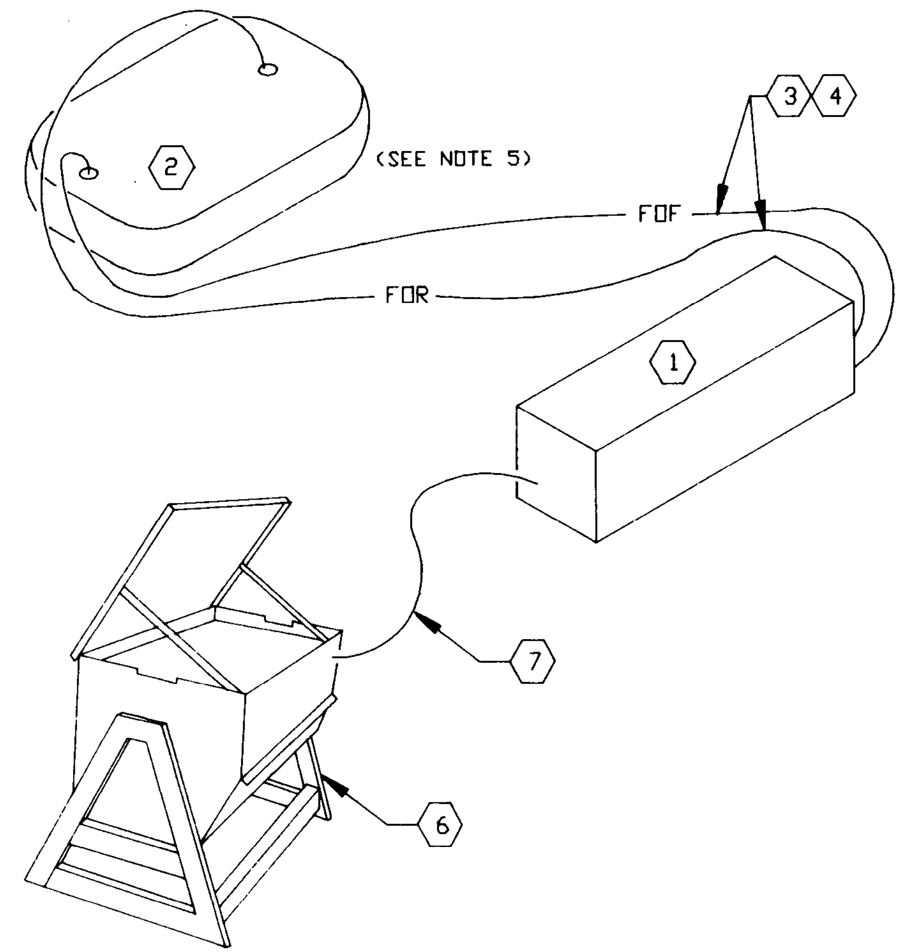
Portable generator systems can be used as a complete system, or individual pieces may be used as required, for each specific situation. In the total system, fuel is stored in bladder tanks and supplied to the generator, using portable fuel hose. The generator will, in turn, use the fuel to operate and supply power to the load center, which acts as a main power panel. Generators used individually can normally be left alone and monitored periodically. When more than one generator is used in parallel, close monitoring should be performed whenever possible. Figures 4-3, 4-4, and 4-5 show operational schematics of three systems.

(2) Bill of Materials. Table 4-4 lists procurement information for the three Stand-Alone Systems.

TABLE 4-4. Bill of Materials for Electric Utility System

| Facility Number | Description | Weight (Lb) | Volume ($ft^3$) | Cost ($) |
|---|---|---|---|---|
| 811 10AE | Electric Power Plant Diesel 30kW | 5959 | 138.9 | 23,265.91 |
| 811 10CJ | Electric Power Plant Diesel 60kW | 7897 | 317.5 | 30,714.54 |
| 811 10CN | Electric Power Plant Diesel 100kW | 9337 | 318.3 | 51,958.54 |

FIGURE 4-3. 30kW Electric Stand-Alone System Operation Schematic




| LIST OF ASSEMBLIES | | | |
|---|---|---|---|
| ITEM | ASSEMBLY | DESCRIPTION | QTY |
| | | FACILITY 811 10AE | |
| ⟨1⟩ | 32017 | GEN STA DSL 416Y/240-208Y/120 30KW | 1 |
| ⟨2⟩ | 20708 | TANK FUEL PILLOW 250 GAL NYLON IMP | 1 |
| ⟨3⟩ | 20658 | FUEL OIL MANIFOLD FOR GENERATORS | 1 |
| ⟨4⟩ | 20659 | FUEL OIL DISTR LINES FOR GENERATORS | 1 |
| 5 | 29702 | EXTINGUISHER FIRE W/BRKT PKP 20 LB | 1 |
| ⟨6⟩ | 30209 | DISTR CTR 480-208Y/120V 30KVA PORT | 1 |
| ⟨7⟩ | 32292 | ELEC CONDUCTOR EXPED 6 AWG 500FT | 1 |

NOTES

1. THESE FACILITIES SHALL BE A MIN DISTANCE OF 50' FROM ANY BUILDING.
2. FUEL CONSUMPTION IS APPROX 3.0 GALS/HR AT RATED LOAD FOR ONE 30 KW GENERATOR.
3. THE GENERATOR VOLTAGE IS 120/208Y VOLTS, 3 PHASE, 4 WIRE; RECONNECTABLE TO 240/416Y VOLTS, 3 PHASE, 4 WIRE.
4. PHASE VOLTAGE OF 208 VOLTS, HAS AN ADJUSTING RANGE OF 197-240 VOLTS; PHASE VOLTAGE OF 416 VOLTS HAS AN ADJUSTING RANGE OF 396-480 VOLTS.
5. GENERATOR REQUIRES GRAVITY FEED FUEL SYSTEM. CONSTRUCT WITH FUEL TANK HIGHER IN ELEVATION THAN GENERATOR. BUILD BERM AROUND 250 GAL PILLOW TANK.
6. PANELBOARD SIZE BASED ON 480 VOLT GENERATOR OUTPUT.

REVISIONS

CIVIL ENGINEER SUPPORT OFFICE

ELECTRIC POWER PLANT
DIESEL 30 KW
W/PILLOW TANK

SIZE F — 80091 — FAC 81110AE

SCALE NONE — SHEET 1 OF 1

REFERENCES

FIGURE 4-3. 30kW Electric Stand-Alone System Operation Schematic

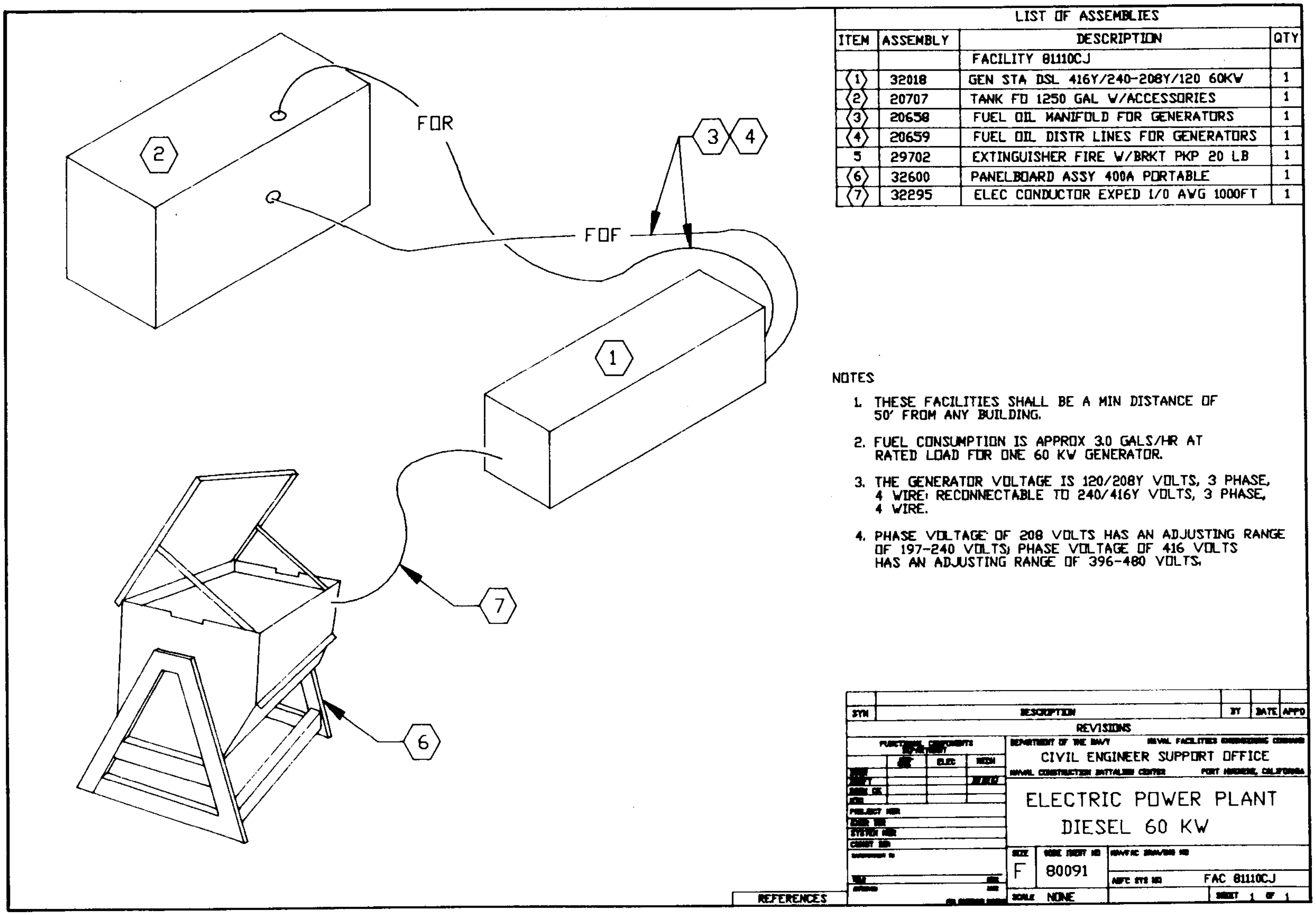
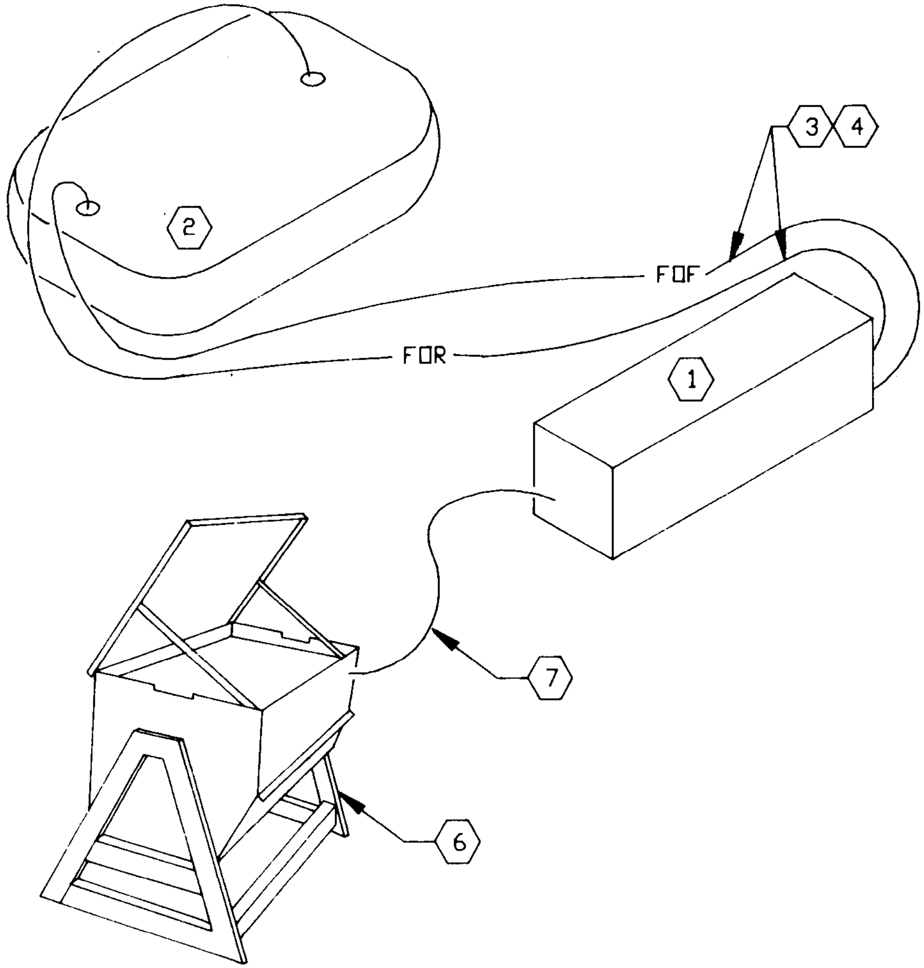



FIGURE 4-4. 60kW Electric Stand-Alone System Operational Schematic

FIGURE 4-4. 60kW Electric Stand-Alone System Operational Schematic




| LIST OF ASSEMBLIES | | | |
|---|---|---|---|
| ITEM | ASSEMBLY | DESCRIPTION | QTY |
| | | FACILITY 81110CN | |
| 1 | 32019 | GEN STA DSL 416Y/240-208Y/120 30KW | 1 |
| 2 | 20010 | TANK FUEL PILLOW 3000 GAL P | 1 |
| 3 | 20658 | FUEL OIL MANIFOLD FOR GENERATORS | 1 |
| 4 | 20659 | FUEL OIL DISTR LINES FOR GENERATORS | 1 |
| 5 | 29702 | EXTINGUISHER FIRE W/BRKT PKP 20 LB | 1 |
| 6 | 32600 | PANELBOARD ASSY 400A PORTABLE | 1 |

NOTES

1. THESE FACILITIES SHALL BE A MIN DISTANCE OF 50' FROM ANY BUILDING.
2. FUEL CONSUMPTION IS APPROX 9 GALS/HR AT RATED LOAD FOR ONE 100 KW GEN.
3. THE GENERATOR VOLTAGE IS 120/208Y VOLTS, 3 PHASE, 4 WIRE; RECONNECTABLE TO 240/416Y VOLTS, 3 PHASE, 4 WIRE.
4. PHASE VOLTAGE OF 208 VOLTS, HAS AN ADJUSTING RANGE OF 197-240 VOLTS; PHASE VOLTAGE OF 416 VOLTS HAS AN ADJUSTING RANGE OF 396-480 VOLTS.
5. FUEL TANK MUST BE ELEVATED IN SUCH A WAY THAT ENGINE FUEL PUMP SUCTION REMAINS FLOODED AT ALL FUEL TANK OPERATING LEVELS.

REVISIONS

CIVIL ENGINEER SUPPORT OFFICE

ELECTRIC POWER PLANT
DIESEL 100 KW
W/PILLOW TANK

F 80091 FAC 81110CN

SCALE NONE SHEET 1 OF 1

REFERENCES

FIGURE 4-5. 100kW Electric Stand-Alone System Operational Schematic

FIGURE 4-5. 100kW Electric Stand-Alone System Operational Schematic

# CHAPTER 5. MATERIAL PROCUREMENT DATA

## 1. INTRODUCTION

**a. Purpose.** This chapter provides general procurement information on couplers recommended in this publication. Sixes are listed in 2-inch increments for data comparison, although sixes from 2 inches to 24 inches are available. Couplers may be available in different widths. Prices listed are those effective at time of publication and are subject to change. Vendors should be contacted directly for latest procurement information.

Dresser and Rockwell couplers can be used with English or Metric units of measurement. Metric measurements must be converted to English units for the Dresser product line. Rockwell couplers may be ordered directly in either the English or Metric systems. In addition, couplers from both product lines have a tolerance of 1/4 inches for variations in pipe diameter.

Technical advice and assistance may be obtained from vendors on issues not covered in this publication. For example, specifics on gasket replacement should be referred to a manufacturer's specialist familiar with the most current materials and procedures applicable to specific geographical and/or operational uses of couplers.

**b. Vendor Information**

Table 5-1 lists manufacturers of coupler products.
Table 5-2 lists a distributor of PVC piping.
Table 5-3 lists Dresser Model 360 Coupler product line.
Table 5-4 lists Dresser Model 38 Coupler product line.
Table 5-5 lists Rockwell Model 225 Coupler product line.
Table 5-6 lists PVC pipes suitable for use in expedient repair.

**TABLE 5-l. Coupler Manufacturers' Names and Addresses**

| Name | Telephone | Address |
|---|---|---|
| Dresser Industries, Inc. | (814) 368-3131 | Bradford, PA 16701 |
| Rockwell Clamp and Coupling Products, Smith-Blair, Inc. | (800) 643-9708 | P.O. Box 5337<br>Texarkana TX 75505 |

**TABLE 5-2. PVC Distributor's Name and Address**

| Name | Telephone | Address |
|---|---|---|
| Ryan Herco Products Corp. | (818) 841-1141 | P.O. Box 588<br>Burbank, CA |

## TABLE 5-3. Dresser Model 360 Coupler with Grade 42 Gasket

| Nominal Size (inches) | Clamp Width (inches) | Part Number | Cost ($) | Weight (Lb) |
|---|---|---|---|---|
| 2 | 8 | 0360-6100-013 | 69.15 | 9 |
| 4 | 8 | 0360-6244-013 | POA | 13 |
| 6 | 8 | 0360-6136-013 | 91.95 | 15 |
| 8 | 8 | 0360-6160-013 | POA | 16 |
| 10 | 8 | 0360-6184-013 | 104.20 | 18 |
| 12 | 8 | 0360-6208-013 | 116.60 | 19 |
| 14 | 12 | 0360-6240-013 | POA | 33 |
| 16 | 16 | 0360-6250-013 | 408.60 | 66 |
| 18 | 16 | 0360-6264-013 | 446.40 | 68 |
| 20 | 16 | 0360-6281-013 | 439.15 | 71 |
| 22 | 16 | 0360-6289-013 | 462.90 | 73 |
| 24 | 16 | 0360-6298-013 | 583.50 | 81 |

POA = Priced On Availability

**TABLE 5-4. Dresser Model 38 Coupler with High Temperature Non-Asbestos Gasket for Steam**

| Nominal Size (inches) | Clamp Width (inches) | Part Number | Cost ( $ ) | Weight (Lb) |
|---|---|---|---|---|
| 2 | 7 | 0038-0013-345 | 70.50 | 9.60 |
| 4 | 7 | 0038-0036-345 | 99.40 | 16.75 |
| 6 | 6.875 | 0038-0057-345 | 143.10 | 25.50 |
| 8 | 6.875 | 0038-0073-345 | 191.40 | 32 |
| 10 | 6.875 | 0038-0085-345 | 250.70 | 40 |
| 12 | 6.875 | 0038-0098-345 | 273.70 | 45 |
| 14 | 9.125 | 0038-0107-345 | 312.20 | 60 |
| 16 | 9.125 | 0038-0115-345 | 337.40 | 70 |
| 18 | 9.125 | 0038-0129-345 | 365.10 | 75 |
| 20 | 9.125 | 0038-0134-345 | 426.60 | 83 |
| 22 | 9.125 | 0038-0509-345 | 633.80 | 108 |
| 24 | 9.125 | 0038-0510-345 | 615.60 | 120 |

**TABLE 5-5. Rockwell Model 225 Coupler with Grade 60 Gasket**

| Nominal Size (inches) | Clamp Width (inches) | Part Number | Cost ($) | Weight (Lb) |
|---|---|---|---|---|
| 2 | 7.5 | 225-10023807-000 | 54.63 | 6.3 |
| 4 | 7.5 | 225-10043207-000 | 70.14 | 7.3 |
| 6 | 7.5 | 225-10064007-000 | 87.73 | 9.1 |
| 8 | 7.5 | 225-10083810-000 | 137.87 | 15.0 |
| 10 | 10 | 225-10106010-000 | 181.60 | 17.0 |
| 12 | 12.5 | 225-10126012-000 | 250.94 | 23.0 |
| 14 | 15 | 225-10140015-000 | 293.54 | 24.2 |
| 16 | 20 | 225-20159220-000 | 847.14 | 74.0 |
| 18 | 20 | 225-20178220-000 | 892.86 | 77.4 |
| 20 | 20 | 225-20199020-000 | 941.43 | 80.5 |
| 22 | NOT AVAIL | ——— | ------ | ------ |
| 24 | 30 | 225-30232830-000 | 2491.00 | 181.10 |

Widths shown are smallest. Larger widths are available.

**TABLE 5-6. Ryan Herco PVC Pile List**

| Nominal Size (inches) | Max Working Pressure (psi) | Part Number | Cost ($ per 100 ft) | Weight (lbs per 100 ft) |
|---|---|---|---|---|
| SCHEDULE 40 | | | | |
| 2 | 280 | 3900-020 | 113.00 | 51.8 |
| 4 | 220 | 3900-040 | 330.00 | 204.1 |
| 6 | 180 | 3900-060 | 581.00 | 359.7 |
| 8 | 160 | 3900-080 | 900.00 | 547.9 |
| SCHEDULE 80 | | | | |
| 2 | 400 | 3905-020 | 162.00 | 94.8 |
| 4 | 320 | 3905-040 | 482.00 | 283.1 |
| 6 | 280 | 3905-060 | 920.00 | 540.6 |
| 8 | 240 | 3905-080 | 1397.00 | 821.2 |
| 10 | 230 | 3905-100 | 2268.00 | 1195.6 |
| 12 | 230 | 3905-120 | 3020.00 | 1643.7 |
| 14 | 220 | 3905-140 | 7230.00 | 1979.0 |
| 16 | 220 | 3905-160 | 8877.00 | 2543.0 |

# CHAPTER 6. PREPOSITION OF MATERIAL and NAVAL, CONSTRUCTION FORCE and STATION FORCES TRAINING

## 1. INTRODUCTION

**a. Prepositioning of Material.** It is up to individual commands to address procurement and prepositioning issues associated with expedient repair materials.

**b. NCF and Station Forces Training.** Repair tasks and procedures addressed in this publication are taught in the appropriate Class "A" schools. Additional training for individual base unique systems should be conducted locally on the job.

# GLOSSARY

| | |
|---|---|
| ABFC | Advanced Base Functional Component |
| ABS | Acrylonitrile Butadiene Styrene |
| AWG | American Wire Gauge |
| CBR | Chemical, Biological, and Radiological |
| kV | kilovolt |
| kW | kilowatt |
| megohm | one million ohms |
| MCM | Thousand Circular Mills |
| NCF | Naval Construction Force |
| psi | pounds per square inch |
| POA | Priced On Availability |
| POL | Petroleum, Oil, and Lubricants |
| PVC | Poly Vinyl Chloride rigid plastic pipe |
| SCUBA | Self-Contained Underwater Breathing Apparatus |

# APPENDIX A

## REPAIR MATERIALS

A variety of pipe sizes is used in the field. It is impossible to address every combination possible. Emphasis is on combinations likely to be encountered in the field. Dresser *Model 360 coupler with a Grade 42 gasket* is recommended to repair pipes in sixes that range from 2 inches to 24 inches. Smaller sections than 2 inches are not considered vital to mission support. Sixes larger than 24 inches would be difficult to repair in a 4-hour period due to problems associated with size and weight. However, sixes to 30 inches are available. The couplers can be used on cast iron, asbestos cement, steel, iron, clay, plastic (PVC or ABS), and concrete. Dresser Couplers can be used where pipe ends are deflected up to 4 degrees or offset 1/8 inch. The shelf life of the gasket is a minimum of 5 years. The coupler can also join pipes with a variation of 1/4 inch outside diameter. This tolerance can eliminate or substantially reduce problems associated with pipes that have different nominal standards. See table 5-3 for procurement information.

*Rockwell Model 225 with a Grade* 60 *gasket* is a similar product and can be used on pipes that range from 2 inches to 24 inches. Sizes to 30 inches are availabe. The Rockwell couplers possess that same characteristics as the Dresser and is considered an equal substitute. See table 5-5 for procurement information.

As Dresser and Rockwell couplers are made for a certain size application, it will be necessary to have on hand couplers in every size likely to be encountered in the field. Individual commands can assess their own utility systems and stockpile what is deemed appropriate.

As couplers are designed to be used with hardwall pipe, it is also necessary to have pipe material on hand to be used for replacement. As in the case of couplers, individual commands can assess their utility systems and stockpile what is deemed appropriate. Each command may procure pipe material similar to what is in the ground. However, it is recommended that one kind of pipe be stockpiled, to the extent possible, to minimize the procurement process. The use of PVC pipe as a replacement is recommended and its use will save on cost and weight. It can be obtained in pipe diameters up to and including 16 inches. See table 5-6 for PVC pipe procurement information.

# APPENDIX B

## GENERAL TOOLS AND EQUIPMENT

a. Earth moving equipment

b. Shovel

c. Trash pump

d. Gloves

e. Goggles

f. Pry bar

g. Wrenches

h. Hammer

i. File

j. Brush

k. Wire brush

l. Soapy water

m. Pipe locators

n. Pipe cutter

o. Pipe scraper and scale remover aids

# APPENDIX C

## REPAIR CONSUMABLES

The following is a list of items likely to be consumed during expedient repair:

a. Pipes

b. Valves

c. Fittings

d. Couplers

e. Fuel for pumps and equipment

# APPENDIX D

## INSTALLATION

a. When undamaged pipe sections are found, cut ends square with a pipe cutter. Remove all burrs that result from cutting pipe.

b. Clean all dirt, rust, oil, or loose scale from pipe ends. Check surfaces where gasket contacts the pipe to ensure that there are no imperfections, such as gouges or grooves, that will impair the performance of the gasket seal.

c. Measure back on each pipe end one half of the width of the coupler and mark. These marks will be used to center the coupler over the joint.

d. Measure and cut a replacement section of pipe. Repeat deburring and cleaning process.

e. Wipe gaskets clean and lubricate gaskets and pipe ends with soapy water. Alcohol may be added to soapy water in freezing weather.

f. Align replacement pipe on both ends.

g. Place coupler over pipe end and align with mark. Rotate coupler until gasket is flat against pipe. Repeat process for other side.

h. Tighten bolts uniformly to recommended torque, as given in table 4-3.

i. Turn on service and check for acceptable level of leakage.